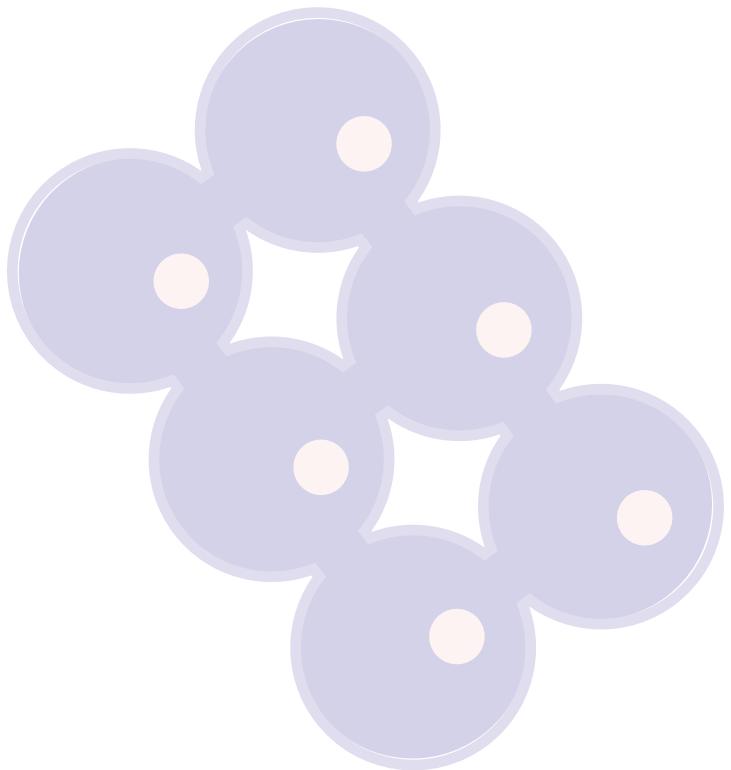




User's Guide **3** to:
Phoenix Vessel Technology Limited
350/400 psi End port pressure vessels 4".
Model number: 3307, 1209.



Phoenix Vessel Technology Limited Unit 2, The Old Bakery, Lower Tuffley Lane, Gloucester GL2 5DP

T: +44 (0) 1452 311673
F: +44 (0) 1452 310295

E: info@phoenixvessel.co.uk
www.phoenixvessel.co.uk

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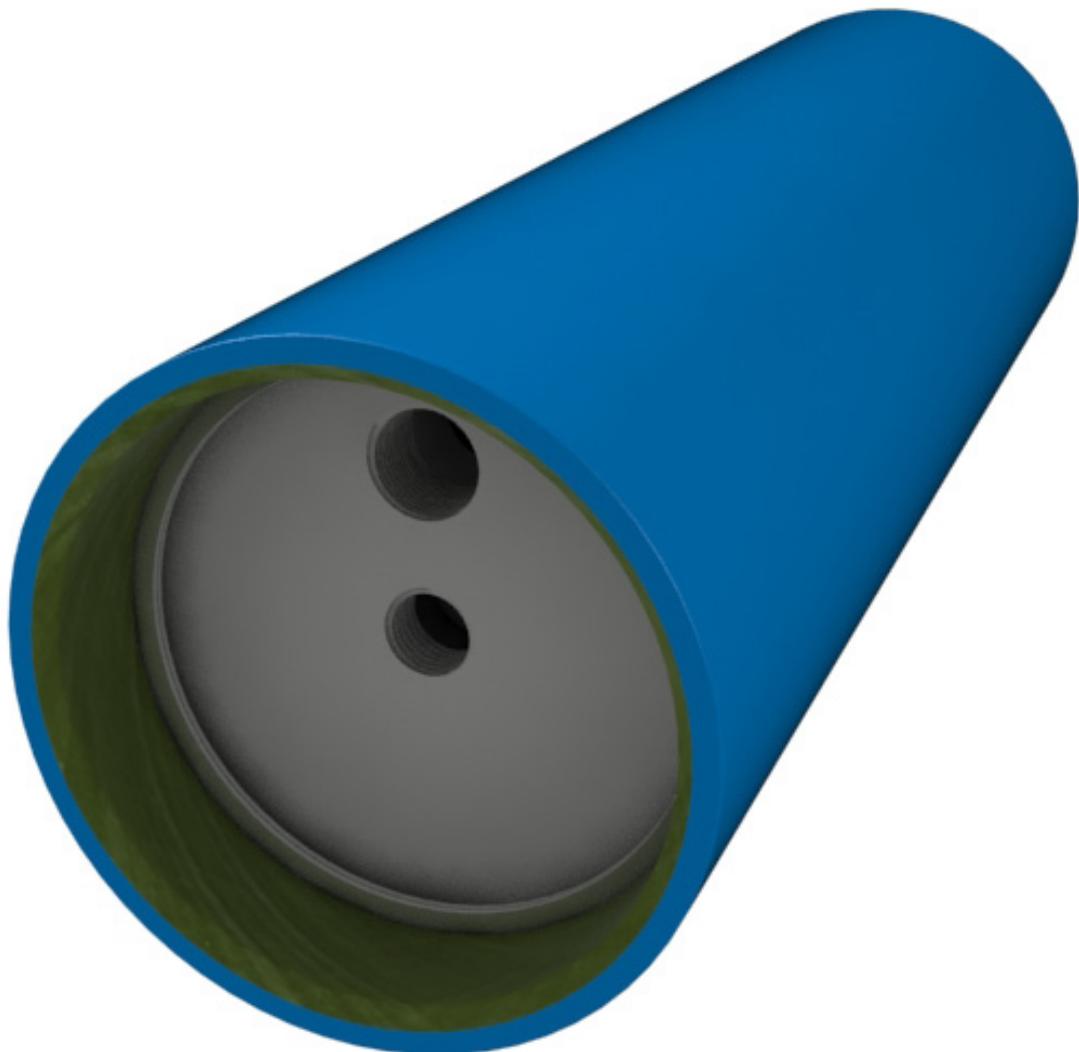
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FORWARD

Phoenix Vessels is a major manufacturer of Glass Reinforced Plastic Pressure vessels which are used as housings for reverse osmosis membrane elements. It is one of a small number of companies with Code X accreditation of the American Society of Mechanical Engineers.

Vessels are produced to cover a range of pressures upto 1000 psi and to house upto six 40" membrane elements.

Each vessel has a documented history in terms of the manufacturing process and the materials used. Before despatch, each vessel is tested to 1.1 times working pressure to ensure structural integrity.



The following Assembly Drawings are applicable:

1MNC 3307 - 4" 350 psi 113°F (45°C)
1MNC 1209 - 4" 400 psi 113°F (45°C)

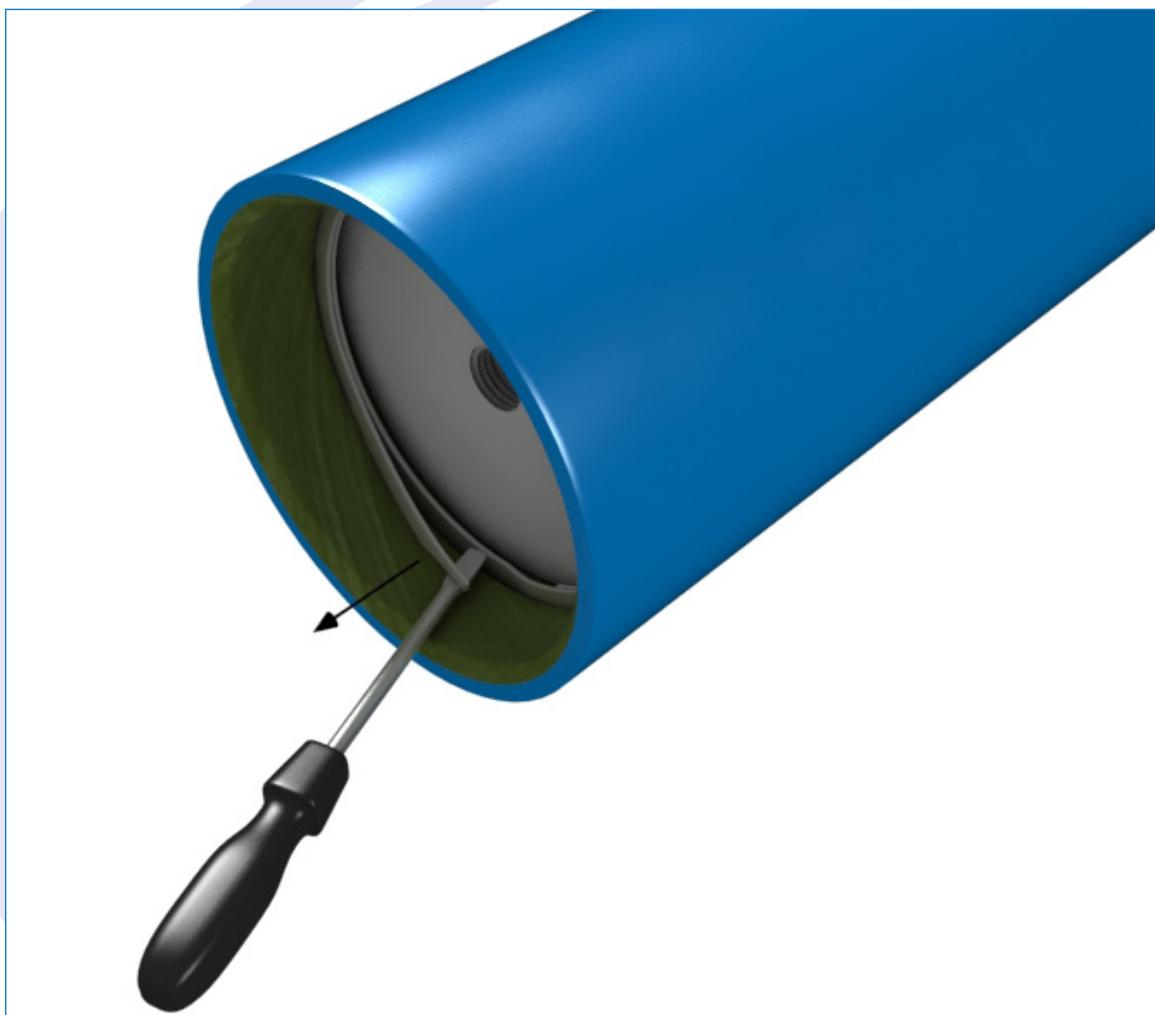
User's Guide Issue: Feb 2012

SECTION ONE

MAINTENANCE GUIDE

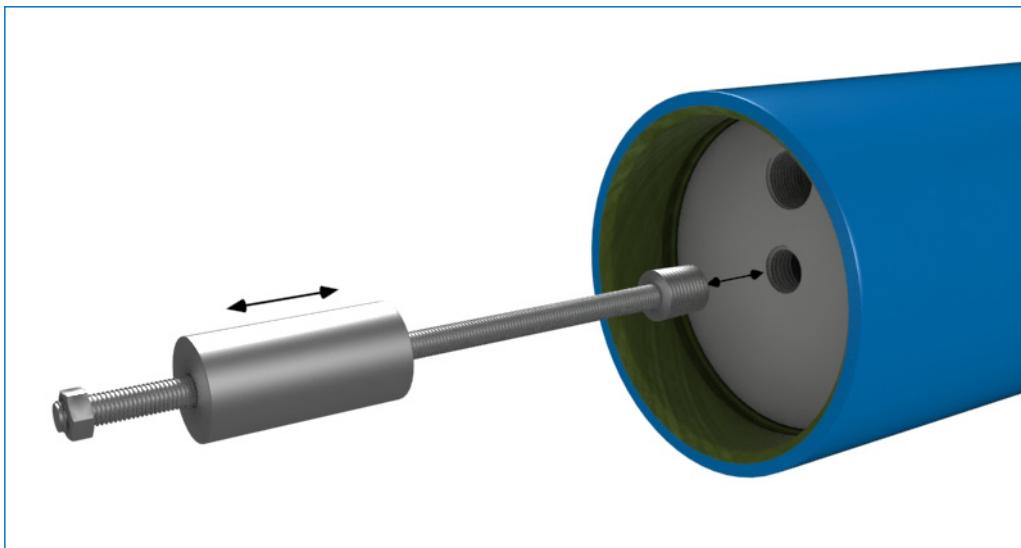
1.1 REMOVING END CAP FROM VESSEL

- 1.1.1 Ensure system is NOT pressurised before starting work.
- 1.1.2. Remove all pipework connected to the vessel end cap.
- 1.1.3. Using a screwdriver lever out the end of the spiroloc circlip from the groove in the vessel. Hold the end of the circlip from springing back into the groove and remove the remaining part by running an index finger behind the circlip with a rotating movement. Note : If the end of the screwdriver is bent over by 15 -30 degrees then extraction is considerably easier.



Note: Any loose debris should be removed by flushing with water and any sharp edges made smooth by lightly abrading with waterproof silicone carbide paper (200 Grade or finer). This should be done before removing the plastic end cap as this will ease extraction.

1.1.4 If the end cap cannot be removed as indicated then the use of an extractor will be necessary. This can be supplied by Phoenix Vessels and is illustrated below.



1.2 LOADING MEMBRANES

This Section is provided as a Guide only, reference should be made to the element manufacturers recommendations for loading.

1.2.1 UNLOADING MEMBRANE ELEMENTS

- (a) Ensure system is NOT pressurised before starting work.
- (b) Remove both end caps from vessel.
- (c) Remove element from vessel following element manufacturers recommendations.

1.2.2 CHECKS BEFORE LOADING

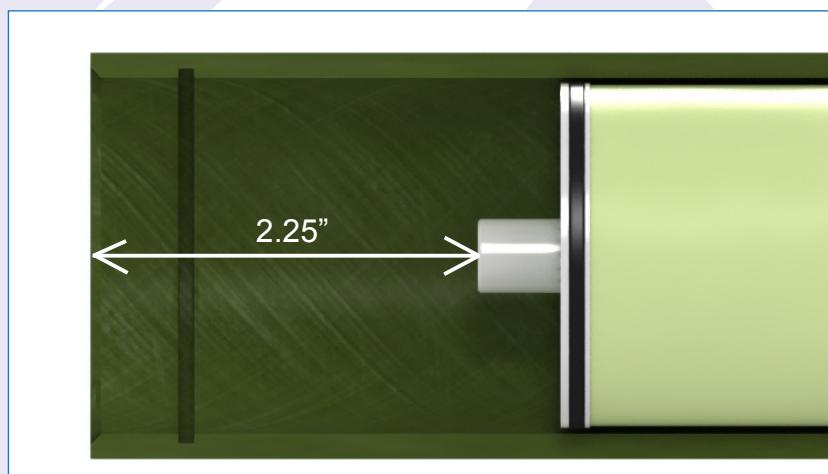
- (a) Check the inside of the vessel for debris which may scratch the vessel. Remove any that is found by flushing with water or by using a clean cloth. Stubborn debris which adheres to the vessel may be removed by lightly polishing the area with waterproof silicone carbide paper. Use 400 Grade (fine) to start with and finish with 600 Grade (very fine). It will help to moisten the grit paper with water during use. Avoid continuously rubbing the same spot in the same direction. Afterwards remove any debris with water or by using a clean cloth.
- (b) Check that there are no sharp edges to the membrane element which could scratch the vessel. Contact the element manufacturer if these cannot be easily removed.
- (c) Check the element brine seal for wear and or cuts. Consult the element manufacturer for spares and advice.

NOTE: Sharp debris may scratch vessel bore. This should be removed before unloading elements.

NOTE: Fine grade Scotchbrite may be substituted for waterproof silicone carbide paper.

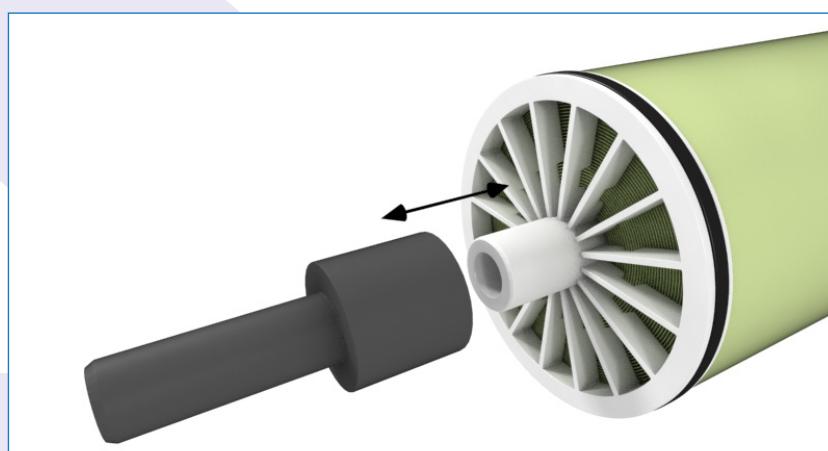
1.2.3 LOADING MEMBRANE ELEMENTS

- (a) Lubricate the inside of the vessel with glycerine. If this is not available then flood vessel with clean water.
- (b) Check with the element manufacturer concerning the position of the brine seal. Normally this is placed on the upstream end of the element with the recessed part of the seal pointing upstream.
- (c) Push the elements into the vessel from the upstream end.
- (d) As each element is loaded insert the interconnector. To ease insertion glycerine should be applied to the O-seals.
- (e) Care should be taken to ensure that the weight of the element is not taken on the interconnectors during loading.
- (f) The final element should be inserted 2.25" in from the end of the vessel.



- (g) The plug and adaptor (multi element vessels) should be removed from the vessel before loading the elements - they may be fitted to either end of the element train.

NOTE : Catastrophic failure of the product line can occur if the adaptor or plug is not fitted and pressure is applied.



(h) For single element vessels (i.e. upto 40" of element length) no adaptors or shims are supplied.
 Multi-element vessels fall into two categories depending on the type of element in the vessel:

- (1) Spigotted type - i.e. has a core tube which is proud of the face of the element. One adaptor and three shims are supplied. The shims are required to ensure that the element remains connected to the pressure vessel end cap, these should be placed between the adaptor and the end cap.
- (2) Flush fitting (also referred to as close coupled) element. This type does not require shims or an adaptor.

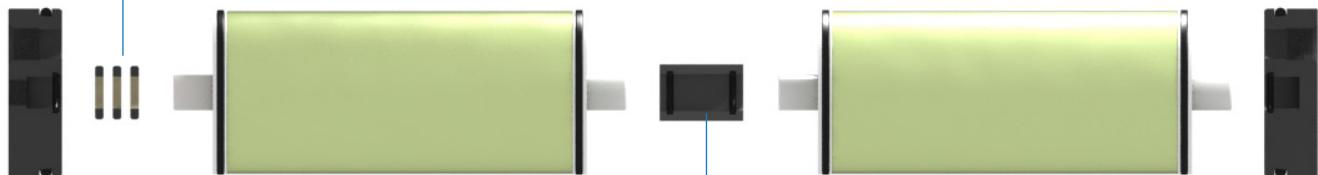
Model: 3307 - 350 PSI

Single element



Multi element
(2 - 6 elements)

shim
(3 max)



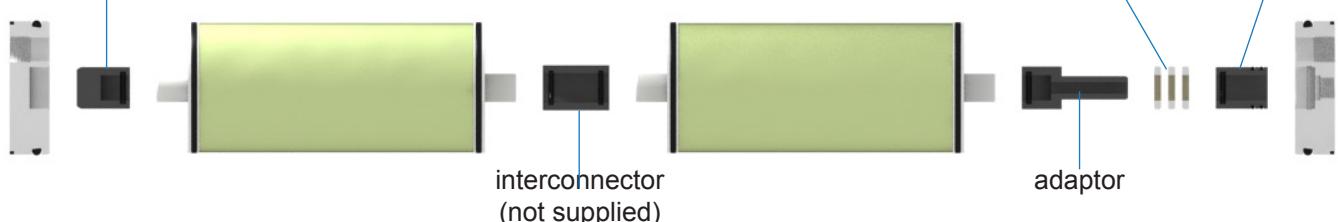
Model: 1209 - 400 PSI

Single element



Multi element
(2 - 6 elements)

plug



The required number of shims may vary between any two vessels loaded with elements due to tolerance build up, each will require measuring to find the exact number required. There are two ways to do this :

Method 1 - Work out the end float from element to vessel by measuring the distance from the face of the element to the groove and subtracting the end fitting thickness. Each shim has a thickness of 10mm, aim to obtain an end float of 2 to 12mm. Thus if the endfloat is 1mm, remove a shim. If it is 13mm, add a shim. A maximum of 3 shims may be fitted.

Method 2 - Fit the maximum number of shims to the adaptor, each has thickness of 10mm and a maximum of 3 maybe fitted to the upstream adaptor. Fit the adaptor onto the core tube of the element. Then remove the large 4" diameter seal from the end fitting so that no resistance will be required to push it into the vessel. Push the end fitting into the vessel until it will go no further. If the full width of the groove in the vessel is visible then the correct number of shims have been fitted. If not, then remove one shim and repeat the above procedure until the groove is visible. Remember to refit the large O-seal.

1.3 CLOSING VESSEL

1.3.1. Thoroughly clean all parts and check for the following.

- (a) O-SEALS - cracked, worn or cut areas.
- (b) END CAP - cracks between ports, distorted or bearing edges worn.
- (c) CIRCLIP - Corroded or badly distorted.

Components which show any of the above should be replaced.

NOTE : It is recommended that O-seals are replaced every time the end cap is rebuilt.

1.3.2. Check the inside of the vessel for debris which may scratch the vessel. Remove any that is found by flushing with water or by using a clean cloth. Stubborn debris which adheres to the vessel may be removed by lightly polishing the area with waterproof silicone carbide paper Use 400 Grade (fine) to start with and finish with 600 Grade (very fine). It will help to moisten the grit paper with water during use. Avoid continuously rubbing the same spot in the same direction. Afterwards remove any debris with water or by using a clean cloth.

NOTE : Fine grade Scotchbrite may be substituted for water- proof silicone carbide paper.

3. Lubricate the vessel inside surfaces with glycerine.
4. Lubricate the assembled end cap with glycerine, particularly the large 4" diameter O-seal.
5. Insert the end cap squarely into the vessel body sufficient to allow the spiroloc circlip to be inserted fully into the groove in the end of the vessel. If the end fitting is difficult to push into the vessel then use the wooden shaft of a hammer to tap it into position.

NOTE : Under no circumstances should undue force be used to insert the end cap. A light tap is all that is required.

If the end cap cannot be easily inserted then the following checks should be carried out.

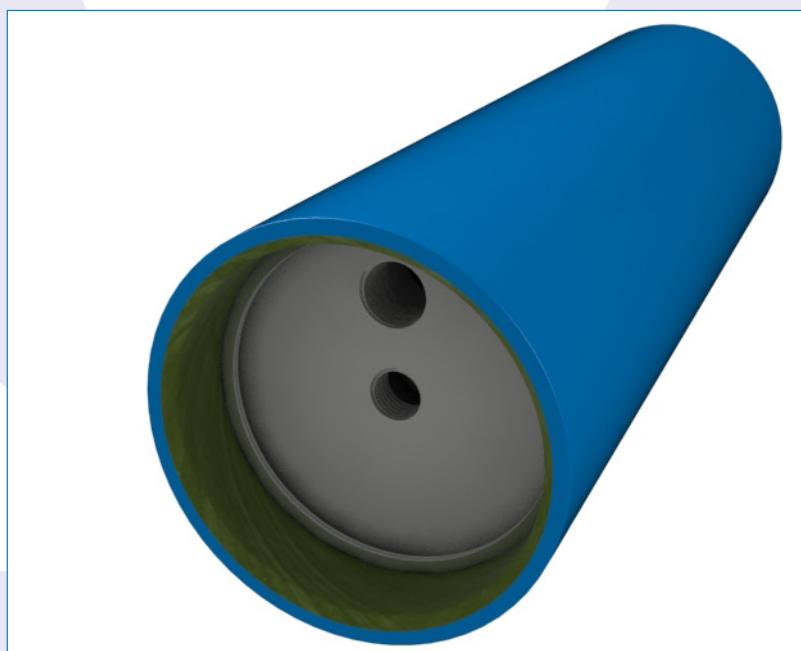
- (i) Lubricate vessel surfaces with glycerine.
- (ii) The elements may have been pushed too far, proceed as follows: Remove large 4" diameter seal from end cap.
- (iii) Insert end cap into vessel. Without the main seal little effort should be required to connect onto the element. If there is insufficient space to insert the spiroloc circlip then the elements have been pushed too far during loading. Remove the last element by pushing it through the vessel taking care to support its weight as it emerges.

Refer to Section 1.2 'Loading Elements' for further information.

NOTE : Remember to refit all O-seals, and plugs/solid adaptors to the central core tube of the last element in the stack.

1.3.3. With the end fitting in place insert the spiroloc circlip into the groove in the vessel. The best technique to use is to lead one end of the circlip into the groove using thumb or index finger and to move thumb round the inside of the vessel pushing the remainder of the circlip into the groove . This is the reverse of the removal sequence refer to Section 1.1 'Opening Vessel'.

NOTE : A partially or badly assembled vessel is dangerous.



SECTION TWO

INSTALLATION

2.1 HANDLING

2.1.1 Vessels may be stored horizontally in any warehouse where the temperatures are as follows:

Maximum 45° C (113° F)

Minimum 0° C (32° F)

2.1.2 DO NOT subject the vessel to sharp blows or impacts as this may damage the vessel wall.

2.1.3 DO NOT use the ports which project beyond the vessel as lifting or manoeuvring aids.

2.1.4 DO NOT scratch the vessel inside wall.

VESSEL DAMAGE

This should be reported to the shipping company upon receipt.

Contact Phoenix Vessels for advice if in doubt.

2.2 VESSEL SUPPORT POSITION

The bending stresses generated in a long pressure vessel can be considerable and should not be ignored. Careful choice of support position can minimise bending stresses to an acceptably low level. Always follow instructions stated on the Assembly Drawing for each particular vessel design and length ordered.

The following is the recommended support positions for 2.5" vessels.

No. of 40" Elements	No. of Supports	Distance between Supports (mm)		Distance between Outer Supports (mm)	
		Max	Min	Max	Min
1	2	800	200		
2	2	1810	620		
3	2	2270	1640		
4	2	2660	2660		
3	3			2830	1640
4	3			3920	2660
5	3			4250	3670
6	3			4650	4650

2.3 CONNECTIONS TO VESSEL

2.3.1 Mount vessels using support saddles provided on horizontal surface at the recommended support position and tighten straps to eliminate movement, do not tighten to more than drawing recommended torque.

NOTE : Excessive torque applied to the straps may damage the vessel wall.

2.3.2. Provide pressure relief device. This should be set to no more than 105% of design pressure.

2.3.3. Allow for an expansion of 0.5mm per metre length of vessel at design pressure.

2.3.4. Connections to end cap are ½" BSPT female thread for the feed and reject ports and 3/8" BSPT female for the product line. The maximum torque applied to the threaded connections should Be as stated in the table below. Note that when the vessel is working in an environment which is hotter than the assembly temperature the thread torque reduces. Similarly as the temperature reduces the assembly torque increases. This is due to thermal expansion of the thermoplastic end cap. Obviously a lightly torqued fitting may leak at high temperature and so recommended torque figures should be followed. If a pre-set torque wrench is used to tighten the fitting into the end cap make sure that at least three 'clicks' are heard i.e. that the torque level is checked at least three times. Often some additional movement is obtained at the second and third attempts.

SECTION THREE OPERATION

3.1 CORROSION

Whilst every effort has been taken to ensure that end fittings have adequate corrosion resistance it is the responsibility of the purchaser to assess that the materials offered are suitable for the specific corrosion environment.

Alternate materials are available with enhanced corrosion resistance, contact Phoenix Vessel Technology Limited for advice.

End fittings should be maintained dry and free from corrosion. Vessel leaks should be investigated and corrected.

3.2 OPERATING CONDITIONS

DESIGN SPECIFICATION

Internal Diameter: To fit any 4" nominal diameter element.

Length: Up to 240" of membrane elements.

Working Fluid: Water

NOTE : The standard materials of construction may not be compatible with cleaning and preserving fluids. Alternative materials are available on request.

Design Pressure: 350 psi (24.2 bar).
400 psi (27.6 bar).

Test Pressure: 1.1 times design pressure for upto 15 minutes maximum.

Design Temperature: 20 to 113° F (-7 to 45° C).

NOTE : Although the minimum design temperature is 20 deg F the vessel should not be allowed to freeze solid. This will damage the vessel wall and make replacement necessary.

Expansion: 0.5 to 0.6 mm per metre length of vessel at design pressure.

Vacuum condition: Vessel end fittings will move out of position under vacuum loads. Contact Phoenix Vessels for advice.

Support Position: 2 supports for 1 to 4 (40") elements.
3 supports for 5,6 (40") elements and any length supported outside of recommended support range (refer to 'Vessel Support Position' Section 2.2 of User's Guide).

3.3 SAFETY PRECAUTIONS

Fibreglass reinforced pressure vessels will provide years of safe service if properly installed and maintained. This section is for guidance only and should be used in conjunction with the recommendations in the previous sections. Attention is drawn to the 'NOTES:' located at the bottom of the page which highlight potential problems areas and safety recommendations.

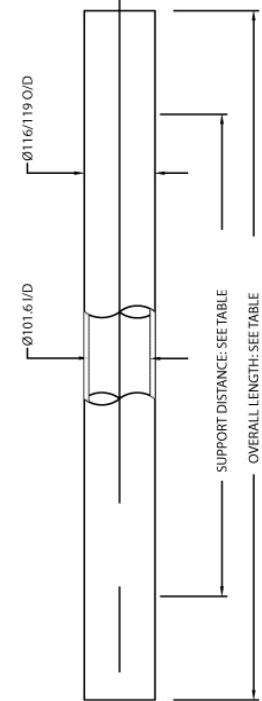
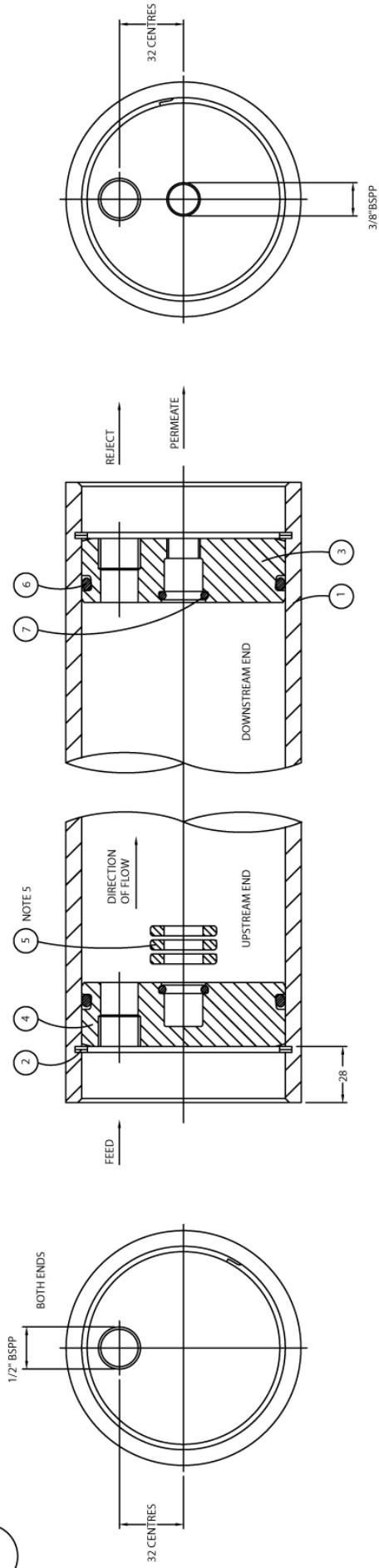
- 3.3.1 Provide pressure relief device. This should be set to no more than 105% of design pressure.
- 3.3.2 Before pressurisation visually check that the 3 part retaining ring is fully in position and secured by the two cap head screws.
- 3.3.3 DO NOT stand in line of end fitting while pressurisation takes place.



SECTION FOUR APPENDIX

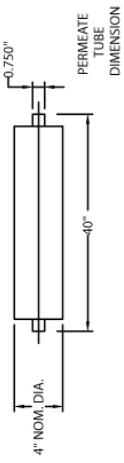
4.1 SPARE PARTS LIST

For part numbers and descriptions please refer to the relevant Technical Information Sheet.



NOTES :

1. GLYCERINE TO BE USED ON 'O' SEAL PATHS TO REDUCE FRICTION.
2. REFER TO USERS GUIDE FOR MORE DETAILED INFORMATION ON INSTALLATION, OPERATION, MAINTENANCE AND SPARES.
3. EACH VESSEL TESTED AT 1.5 TIMES DESIGN PRESSURE FOR 15 MINUTES TO ENSURE NO LEAKS.
4. DESIGN PRESSURE: 350 psi
DESIGN TEMPERATURE: 0°C TO 45°C.
DO NOT ALLOW VESSEL CONTENTS TO FREEZE.
5. FOR 4, 5, 6, 7 LENGTHS, SHIMS (ITEM 5) ARE REQUIRED. PLACE 1, 2 OR 3 SHIMS OVER THE ELEMENT CORE TUBE AT THE UPSTREAM END ONLY.
6. SUITABLE FOR 40° ELEMENT WITH 0.750 INCH DIAMETER Male PERMEATE TUBE:



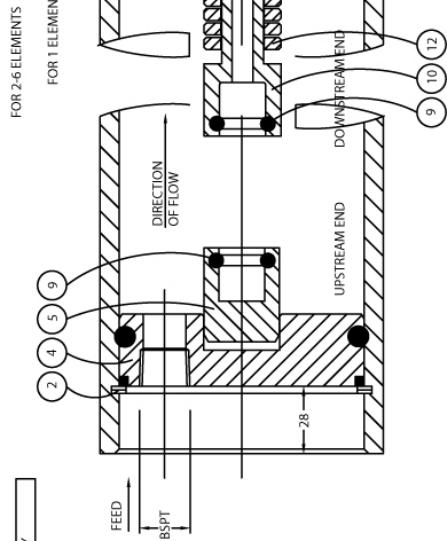
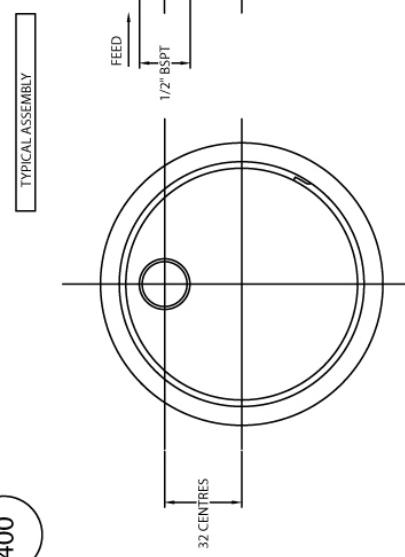
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ONLY for	
This drawing print to be used	
Date	Signature
TO BE RETAINED IN JOB FILE	
Job Number PH	

NO. OF 40° ELEMENTS	OVERALL LENGTH + 4mm	MAX SUPPORT POSITION mm	MIN SUPPORT POSITION mm	MAX DRY WEIGHT kg.
1	1097	800	200	8
1.5	1605	1300	400	11
2	2113	1810	620	14
3	3129	2270	1640	19
4	4147	2660	2660	25
4.5	4655	2980	2980	28
5	5163	4250 C	3670 C	31
6	6179	4650 C	4650 C	36
7	7195	5400 C	5400 C	41
		C - CENTRAL SUPPORT REQUIRED		
		14" (1a)	300	5
		21" (1a)	450	6

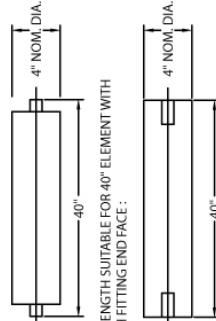
7 " O SEAL FOR MEMBRANE	EPDM	BS 210	2	4"
6 " O SEAL FOR END CAP	EPDM	BS 342		
5 " SHIM (FOR 4-7 LENGTHS)	ABS	PVL 340/3		
4 " END PLATE B	UPVC	BSPT		
3 " END PLATE A	UPVC	BSPT		
2 " CIRCLE CLIP RING	STAINLESS STEEL	PVL 2892	NPT	
1 " VESSEL BODY	GLASS FIBRE EPOXY RESIN	PVL 1241		
		PVL 3135		

1MNC 3307

SCALE : NONE
DIMENSIONS : MILLIMETRES
ISSUE : B BY : MCC APPD : DATE : 28 FEB 05



NOTES :

6.1A LENGTH SUITABLE FOR 40" ELEMENT WITH
MALE PERMEATE TUBE :7.1B LENGTH SUITABLE FOR 40" ELEMENT WITH
FLUSH FITTING END FACE :

THRUST RING	PVC	TO-SUIT MEMBRANE
SADDLE	URETHANE/EDPM	PVL 40-10-1534
STRAP	STAINLESS STEEL/NEOPRENE	PVL 40-0-1115
12 SHIMS	UPVC	PVL 40-10-1728
11 O SEAL FOR SINGLE ELEMENT LENGTH ADAPTOR	NITRILE WRIC LISTED UPVC	200-209-2064
10 O SEAL FOR HUB	NITRILE WRIC LISTED UPVC	TO-SUIT MEMBRANE
8 O SEAL FOR HUB	NITRILE WRIC LISTED UPVC	TO-SUIT MEMBRANE
7 O SEAL FOR END CAP	NITRILE WRIC LISTED UPVC	200-121-2064
6 HUB	UPVC	200-342-2064
5 PLUG	UPVC	TO-SUIT MEMBRANE
4" END PLATE B	ACETAL	40-04-1264
3" END PLATE A	ACETAL	1/2"-1/2" BSP
4" END PLATE B	ACETAL	40-04-1265
3" END PLATE A	ACETAL	40-04-1266
2 CIRCLIP RING	ACETAL	40-04-1237
1 VESSEL BODY	STAINLESS STEEL	40-04-1236
	GLASS FIBRE EPOXY RESIN	PVL 40-04-1241
		PVL 40-04-1240

IMPORTANT		
ONLY for		
This drawing print to be used		
Job Number PH	Date	Signature
TO BE RETAINED IN JOB FILE		

NOTES :

1. GLYCERINE TO BE USED ON 'O' SEAL PATHS TO REDUCE FRICTION.

2. REFER TO USERS GUIDE FOR MORE DETAILED INFORMATION ON INSTALLATION, OPERATION, MAINTENANCE AND SPARES.

3. EACH VESSEL TESTED AT 1.5 TIMES DESIGN PRESSURE FOR 15 MINUTES TO ENSURE NO LEAKS.
4. DESIGN PRESSURE 400 PSI
DESIGN TEMPERATURE 0°C TO 45°C.
DO NOT ALLOW VESSEL CONTENTS TO FREEZE.
5. IF ADAPTOR ITEM 10 IS PLACED AT UPSTREAM END OF VESSEL ie AS SHOWN ABOVE WITH FEED AND BRINE FLOWS REVERSED, THEN ITEM 12 IS REQUIRED TO PREVENT ADAPTOR SEPARATING FROM ELEMENT.

1	1143	800	200	8
1b	1194	800	200	8
1a	1651	1300	400	11
1.5a	1702	1400	400	11
1.5b	2210	1810	620	14
2	3226	2270	1640	19
3	3226	2270	1640	19
4	4242	2660	2660	25
4.5	4750	2980	28	28
5	5258	4250 C	3670 C	31
6	6274	4650 C	4650 C	36
7	7290	5400 C	5400 C	41
		C - CENTRAL SUPPORT REQUIRED		
14" (1a)	483	300	200	5
21" (1a)	660	450	200	6

1 MNC 1209	SCALE : NONE
DIMENSIONS: MILLIMETRES	ISSUE : H BY : BKF APPD : BKF DATE : 28 AUG 2002